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## Synopsis

Title:

**"Diversity of Amphibian fauna from lentic and lotic water habitats in Parbhani District of Maharashtra, India"**

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**Ph.D. Programme**

In the subject

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## Abstract of proposed work plan / problem:

Amphibian species show a very high level of diversity and endemism and are facing global declines from the past few decades. Studies have shown that the molecular tools can be helpful in their conservation efforts. In India more than 80 percent of amphibians are endemic and most show a narrow range of distribution. Most of the amphibians due to lack information not identified from most of the areas. This research work will focus on the amphibian distribution and diversity in Parbhani district with specific focus on conservation. The present research work undertaken to study the amphibian fauna of Parbhani district is relevant to taxonomy, life history, species richness, abundance, distribution and seasonal variations.

## 1. Introduction:

The vertebrate group Amphibia is characterized by their ability to exploit both aquatic and terrestrial habitats. Some species are permanent land dwellers, while other species have a completely aquatic mode of existence. Amphibians are clades of over 8400 species that provide unique research opportunities (Molly *et al.*, 2021). Today amphibians are represented by frogs and toads (order Anura), newts and salamanders (order Caudata), and caecilians (order Gymnophiona). The orders make up subclass Lissamphibia. The biology and anatomy of amphibian groups demonstrate features possessed by reptilian ancestors. Reptiles and amphibians occupy a diverse range of habitats and microhabitats and are found from deserts to grass-lands, from forests to oceans and from hills to our own houses. India is very rich in these two groups of vertebrates' diversity (Anukul Nath *et al.*, 2012). There are more than 314 species of amphibians (Dinesh *et al.*, 2011) found in India. Many amphibians are obligate breeders in standing water. Eggs are laid in water, and the developing larvae are essentially free-living embryos. In the ecosystem amphibians play a pivotal role as secondary consumers in many food chains.

The tadpoles have a significant impact in nutritional cycling. However adult amphibians are the best biological pest controllers. Amphibians can affect both ecosystem structure through soil burrowing and aquatic bioturbation and ecosystem functions such as decomposition and nutrient cycling through waste excretion and indirectly through predatory changes in the food web (Nalinaksh & Nath, 2023). In the world now amphibians show a very high level of diversity and endemism and are facing a global decline due to the ever-increasing anthropogenic activities from the past decades (Stuart *et al.*, 2004). Although most amphibians live in freshwater in at least their larval phase, many species evolved different degrees of

independence from water including direct terrestrial development. Of a total of 5828 amphibian species considered, 4117 are aquatic in that they live in the water during at least one life-history stage, and a further 177 species are water dependent (Migul & Jorn 2008).

Studies have shown that the habitat modification has led to population declines in many species of amphibians (Arntzen *et al.,* 2017). At present, India has 437 amphibian species (Frost 2019), of which 80% are endemic and concentrated in three biodiversity hotspots, namely the Western Ghats, Himalayas and northeast India (part of Indo-Burma hotspot). About 4% of the amphibian species are critically endangered, 2% are near threatened, and others have not yet been assessed by IUCN (Dinesh *et al.,* 2019). In a healthy ecosystem, a diverse and balanced number of species exist to maintain the balance of an ecosystem. In an ecosystem, all the species depend on each other directly or indirectly. So, to make a more efficient, productive and sustainable ecosystem**,** it is important to maintain high species diversity. The population of amphibian diversity is facing global declines from past decades. The investigation of amphibians' diversity can be helpful in their conservation efforts.

## 2. Review of Literature and Development in the subject:

**(Previous work done in the relevant area):**

**Priti *et al.,* (2019)** during investigation on the *Conservation genetic studies of Indian amphibians and their implications on developing strategies for conservation* noted that amphibian diversity shows endemism and are facing global declines from the past few decades. The molecular tools can be helpful in their conservation efforts. In India, more than 80 percent of amphibians are endemic and most show a narrow range of distribution.

**Suman Pratihar *et al.,* (2014)** during study on *Diversity and conservation of amphibians in south and southeast Asia* find out that the southern and southeastern parts of Asia host high amphibian diversity and comprise four biodiversity hotspots. 285 amphibians are endemic to South Asia, 342 are distributed in India and 119 in Sri Lanka. They documented the distribution, threats, and conservation status of amphibians in the major countries of southern and southeastern Asia and listed smaller countries with species numbers. Recommended that conservation is an umbrella concept for the diversity of amphibians.

**Nalinaksh & Bhrigunath (2021)** investigated the *Habitat preferences and species diversity of anuran amphibians of Gaya India.* They observed Anuran's diversity and richness in and

around the study area of Gaya district and recorded a total 10 anuran species under 4 families and 7 genera. The study was based in the lentic and lotic regions of Gaya which shows severity of the threats and also proposed several conservation strategies in the study area.

**Basundhara & Bhoj (2020)** has investigated on *Distribution of amphibians along an elevation gradient in the Eastern Himalaya, India.* They studied amphibian distribution along the elevation gradient in Sikkim, Eastern Himalaya, part of a globally significant biodiversity hotspot covering 300-4600 m elevation using Visual Encounter Survey and Night Stream Survey methods. Recorded 25 species and 1368 individuals of amphibians along the elevational gradient.

**Hayat & Gajanan (2020)** worked on *Amphibians of the Melghat, Maharashtra, India.* Their results were favourable in comparison with those of previous surveys. Total 13 species were identified from Melghat Region which are included on the IUCN Red List as being of least concern, local populations could be declining as a consequence of habitat destruction, alteration, and fragmentation, road kills, and the increasingly extensive use of pesticides and herbicides by local farmers in the Melghat.

**Pandhye & Ghate (2000)** *overview of Amphibian fauna of Maharashtra State* and noted that there are 43 species of amphibia in Maharashtra State of the 224 species found in India, distributed among six different families. Out of seven genera endemic to the western ghats, three are represented Maharashtra State.

**Pawar *et al.*, (2000)** while studying on *Preliminary data on species diversity of amphibians and reptiles from Panvel, Navi Mumbai.* The results showed that a total of 8 species of amphibians 6 genera and 4 families were recorded. High diversity of tree frogs and bullfrogs is correlated to the few landscapes with thick vegetation, suitable habitat and optimum rainfall in the study area. It can be concluded that over-exploitation of natural resources in the Panvel region due to ongoing construction of Navi Mumbai.

**Sajjan M B (2019)** submitted thesis to Shivaji University, Kolhapur (M.S.) on the topic *Diversity of Amphibians from Sangli and Solapur Districts Maharashtra.* The results in the spotting of 29 amphibian species belonging to 18 genera, 09 families and 02 orders. Amongst, the order Anura has a maximum number of 16 genera, 07 families and 26 species followed by order Gymnophiona has 02 genera, 02 families and 03 species.

**Nripendra Kumar Choudhury (2004)** submitted PhD thesis on the topic *Diversity of amphibian fauna of the Brahmaputra valley of Assam* at Gauhati University, Gauhati, Assam. During investigation a comparison of the food habits among amphibians of grassland and woodland habitats was made, and identified 30 species from the study sites, belonging to two orders – Anura (29 species) and Gymnophiona (one species) has been recorded. He noted that the landscape and vegetation of Assam has been changed significantly. The main threats were identified as loss of forest, change in land use pattern, flood and siltation and pollution of the habitat.

**Mohitii Mohan Borah (2004)** submitted PhD thesis on the topic *A study on distribution of amphibian fauna of Arunachal Pradesh with special reference to habitat ecology of tadpoles* at Gauhati University, Gauhati, Assam. During his study Mohitii recorded a total of 33 species belonging under 5 families and 16 genera have been collected and investigated. Ethnozoological inventories of the collected amphibian species were made. He noted that the tadpoles and adults of different amphibian species have been used as food, medicine and other ritual purposes by indigenous people of the state, and focused on the documentation and conservation of amphibian species which have been being over exploited.

This review emphasises the necessity of the endless searching and examination of the amphibians from Parbhani district because no specific research work was done before. If work done so far is poorer in the selected study area. Therefore, a present investigation was undertaken to identify and find out the distribution of the amphibian species.

## 3. Objectives of Research / Proposed Hypothesis:

The present research work will be based on the following objectives: -

1. To identify the amphibian species diversity by using standard taxonomic keys.
2. To study the life history, diversity of vocal sac (male frog), egg laying site and embryonic and larval development of some species of amphibian.
3. To explore species richness and abundance in the different study sites.
4. To study the geographical distribution and seasonal variations among amphibians.
5. To prepare a checklist of the amphibian species.

**4. Methodology to be adopted:**

**Amphibian Sampling:**

The samplings will be carried out across the different Lentic and Lotic locations in Parbhani district. The geographic area of the district has varied habitats flowing and stagnant waters. Amphibian sampling work will be carried out seasonally. Different methods mentioned below will be employed to find out the diversity, distribution and seasonal variations and reproductive behaviour in each site. Every site will be observed during the day and night hours to collect detailed information. Use of GPS system for the geographical coordination from sampling sites. Geographic maps of the study sites will be prepared by using DIVA-GIS (Hijmans *et al.,* 2002). Survey of amphibian species will be carried out by following methods for executing the goals of the present research work:

**1. Visual Encounter Survey (VES) Method (Heyer *et al.*, 1994)**

This is a standard sampling method developed for measuring and monitoring the amphibian species diversity by IUCN/SSC- DAPTF (Crump and Scott, 1994; Heyer *et al.,* 1994; Doan, 2003). In this method, one or more observers search the animals in a defined area for a specified duration of time.

**2. Line Transects Method**

Quantification of anuran diversity will be performed by using the line transect method. The two 100 m line transects will be laid at each site. Transects will be laid to overlap all possible breeding habitats. The species number and species abundance will be recorded for each transect by the visual encounter. The existent number of individuals encountered during transect sampling will be used to determine relative species abundance at each study site. Quantitative data generated from transect studies will be used to estimate species richness and abundance. Shannon's index of diversity was estimated.

**3. Bio-Acoustic Encounter Survey**

During the visual encounter survey calls of anurans will be compared with the known calls of android mobile application. Frog find 1.1 and downloaded calls from Amphibiaweb.org to identify the anuran species.

**4. Systematic Analysis:**

**Morphometric Study:**

**a) Anuran Study**

During the field study, particularly in the breeding season, adult anuran species will be collected randomly and morphometrical measurements will be done in both sexes.

**b) Caecilian Study**

Morphometrical measurements and associated terminologies for caecilians study follow Giri *et al.*, (2004).

**c) Reproductive Behaviour**

Immediately after rainfall, suitable habitats such as temporary and permanent water bodies will be specifically explored for the eggs and tadpoles. Observations on breeding behaviour and ecology will be observed during the monsoon seasons (May to September).

**Ecological Parameters:**

The physicochemical parameters of the breeding ponds will be recorded. The ecological parameters are the altitude, rainfall, the relative percentage of humidity and air temperature. Physicochemical parameters are water temperature and pH. Air and water temperatures will be measured by using a Mercury thermometer. Temperature and relative percentage of humidity will be recorded by a digital hygro-thermometer. Water pH will be recorded by pH meter (digital). Rainfall data will be collected from the Regional Meteorological Center.

**Statistical Analysis:**

MS Excel 2007 software was used for statistical analysis and to draw graphs of family-wise population percentage, relative species abundance, Simpson and Shannon diversity index and seasonal variation.

**Statistical formulae:**

**a. Family wise population percentage** $= \frac{T_F}{T_A} \times 100$

Where, $T_F$ = total individuals in a family

$T_A$ = total individuals in a community

**b. Relative Species Abundance** $= \frac{T_S}{T_A} \times 100$

Where, $T_S$ = total individuals of a species

$T_A$ = total individuals in a community

**c. Simpson's index of diversity,**

$1\text{-}D = 1 - \frac{\sum n(n-1)}{N(N-1)}$

Where,

$n$ = total number of individuals of a particular species

$N$ = total number of individuals in a community

**d. Shannon's H index,**

$H = -\sum \frac{n_i}{N} \ln \frac{n_i}{N}$

Where,

$n_i$ = total number of individuals in a species i

$N$= total number of individuals in a community

**e. Seasonal Variation,**

$SV = \frac{T_{IS}}{N_S}$

Where,

$T_{IS}$ = total number of individuals in a particular season

$N_S$ = number of sites where species observed

**Study Area:**

Parbhani, earlier also known as "Prabhavatinagar", is one of the Eight districts in the Marathwada region of Maharashtra State. This entire Marathwada region, a district geographical region, was a part of the erstwhile Nizam State, later a part of Hyderabad State, after reorganization of states in 1956 it became a part of the then Bombay state and from 1960 onwards it is part of the present Maharashtra state.

**Geography**

Parbhani district lies between 18.45 and 20.10 North Latitudes and 76.13 and 77.39 East Longitude. The district is bounded on the north by Hingoli and Buldhana districts. On the east by Nanded and Hingoli, on the South by Latur and on the West by Beed and Jalna districts. The hills on the north east form part of the Ajanta Hill ranges which passes through Jintur Tahsil. The hills on the southern side are the Balaghat Hill ranges. The district is at an average height of 357 m from mean sea level.

**Rivers:**

Parbhani district is largely supported with a network of rivers which are tributaries of Godavari, the main river in the region; Godavari, Purna and Dudhana and its tributaries.

Identification and Distribution of amphibian species from different lentic and lotic sites located in the Parbhani district. As the total average area under the lentic (stagnant) water like reservoirs and ponds is about 8721 ha (District Irrigation Department).

**Reservoirs:**

Major dams in Parbhani district are Yeldari dam which is on Purna river, Lower Dudhana is on Dudhana river, Mudgal barrage on Godavari river, Mosoli dam on Masoli river.

**5. Importance of study / Society application:**

The present study is based on the identification of amphibian diversity present in Lentic and Lotic regions at Parbhani district. Amphibian species play a crucial role in ecosystem services and are very beneficial for human beings by providing services as a food source, in medical research and contribution to regulating services by reducing mosquito and controlling other pest species directly through predation. Amphibian species are one of the most threatened groups of animals, with approximately one third of known species being endangered. The

reasons for this are habitat degradation and loss, over-exploitation etc. This study will be informative, useful in assessing the status of amphibian population and species in the Parbhani district which was not done yet. As amphibians show a very high level of diversity and endemism and are facing global declines from the past few decades. This study can be helpful in their conservation efforts.

**International status:**

The systematic assessments of the amphibian species extinction risk at regular intervals are necessary for the conservation action. At international level the ongoing developments in taxonomy, threatening processes and research further underscore the need for reassessments. The reports of the second Global Amphibian Assessment, evaluating 8011 species for the International Union for Conservation of Nature Red List of Threatened Species. The investigations showed that amphibians are the most threatened vertebrates' class (40 percent of species are globally threatened). The updated Red List Index shows that the status of amphibians is deteriorating globally.

**National Status:**

According to a study 73.6 percent of Indian amphibians are endemic and most show a narrow range of distribution. Information on amphibian diversity and distribution has been used to assess the species. Amphibian research has grown rapidly over the last few decades, expanding from early focus. The Western Ghats in India is a very important global hotspot for amphibian diversity (Myers et al., 2000). It hosts over 200 species of amphibians. Indian researchers working on certain molecular tools which can be helpful for the conservation of endemic amphibian species.

**Significance of the study:**

Amphibians provide provisioning services by serving as food, medical research, acts as predator for certain harmful insect species. In ecosystem amphibians play a crucial role as secondary consumers in many food chains. The present study will be helpful for collecting information of amphibian diversity, their distribution, habitat fragmentation, threats and conservation majors in the Parbhani district.

**6. Proposed work Plan / Formulation and Structure of Study: Year-wise Plan of work and targets to be achieved:**

| Year wise plan of work & targets | |
|---|---|
| **Years** | **Work plan** |
| First Year | Site Selection, references collection & seasonal observations |
| Second Year | Seasonal observations, species identification, data collection & references collection |
| Third Year | Seasonal observations, species identification, data collection, references collection & writing work |

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